



Armed Forces College of Medicine AFCM



Basal Metabolic Rate (BMR)
&
Specific Dynamic Action
(SDA)
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INTENDED LEARNING OBJECTIVES (ILO)



By the end of this lecture the student will be able to:

1. Define basal metabolic rate (BMR)
2. List the basal conditions for the BMR
3. Explain the physiological factors affecting the BMR
4. List the pathological factors affecting the BMR
5. Explain specific dynamic action (SDA) regarding (definition, its values for different food stuffs and the factors affecting it)

Basal Metabolic Rate



It is the rate of energy production/h/square meter surface area under basal conditions

1-
Complete
physical
rest

2-
Complete
mental
rest

3-
Comfortable
room temp.

4-
Post -
absorptive
state

Basal Metabolic Rate

The basal conditions



1- Complete physical rest

The person should be at physical rest for at least 30 min. before the test to avoid Ms. Exertion on heat production



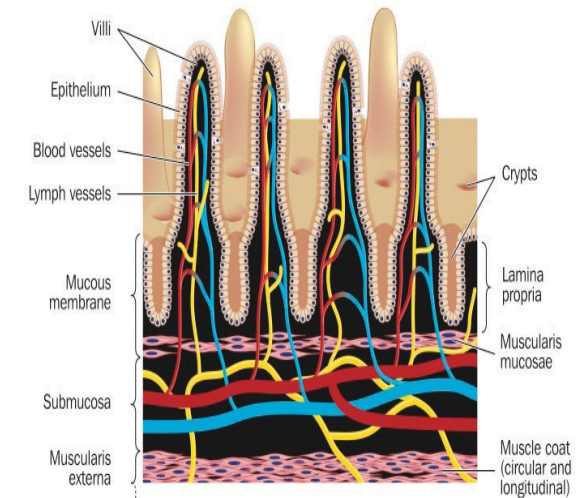
2- Complete mental rest

- To prevent a rise in epinephrine sec. & ↑ MR



3- Comfortable room temp.

To avoid shivering which ↑ heat production



4- Post - absorptive state

No food for about 12-14 h. before the test to avoid diet - induced thermogenesis



- The BMR of a man of average size is about 2000 kcal/d ???????
- It represents the unavoidable cost of life
- One variable that correlates well with the metabolic rate in different species is the body surface area, since heat exchange occurs at the body surface

BMR



- Clinically, the BMR is usually expressed as a percentage increase or decrease above or below a standard normal values for that age and sex

- In a normal adult male, BMR is about 40

Cal/h/m²

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GIT and Metabolism Mona Gamal

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- If his BMR is 60 Cal/h/m², it is expressed as

Factors that affect BMR



Physiologic
al factors

Pathological
factors

Chemical
factors

Factors that affect BMR



1. Physiological factors:

* Age

Newborn = 25 C/H/M²

Age 2-5 years = 60 C/H/M²

Age 20 years = 40 C/H/M² (adult level)

Above 20 years → Decreased 1 C ./10 years ???



Physiological factors:

*Sex

BMR is lower in female than in males by about 7 % due to

- more fat store with little metabolic activity
- Less muscle bulk & Lack of male sex hormone

* Race

Orientals and Africans have lower BMR than

Factors that affect BMR



Physiological factors:

* Climate

= BMR is higher 10 % in individuals in cold climates

= BMR lower in individuals in tropical (hot) countries

* Sleep

?????

= Lower BMR by 10-15% due to:

a- Decreased skeletal muscle tone

b- Decreased activity of Sympathetic Nervous

Factors that affect BMR



Physiological factors:

Physical habits

= The maximum metabolic rate reached during exercise is often said to be 10 times the BMR due to:

- * more muscle bulk
- * lesser amount of fat stores

Dietetic habits



Factors that affect BMR



Physiological factors:

Anxiety & stress

= Higher BMR, due to:-

increase the level of stress hormone

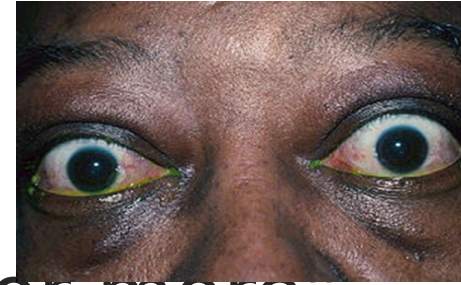
(adrenaline, noradrenaline & cortisone)





2. Pathological factors

A- Higher BMR in



- * **Hyperthyroidism** “up to 100 % or more
- * **Hyperpituitarism**: “-G.H. - TSH - ACTH”
- * **Hypoparathyroidism** “increased muscle tone”
- * **Hyperadrenalism** : “more secretion of catecholamines”
- * **Hyperpyrexia**: Higher BMR by 10-14% for each



Factors that affect BMR



2. Pathological factors

* Heart failure

- Higher BMR “increase activity of respiratory muscles”



* Diabetes insipidus

- Higher BMR to maintain body temperature “excess water loss & water intake”

* Some blood diseases “e.g. Leukemia”

Factors that affect BMR



2. Pathological factors

B- Lower BMR

- * Hypothyroidism

- * Hypopituitarism

- * Hypofunction of adrenal cortex

- * **Hypothermia:** Decreased BMR 10 % for each





2. Pathological factors

* Prolonged starvation decreases the BMR up to 40%

due to

- Depression of SNS
- Decreased catecholamines
- Decreased thyroxine and corticoids



* **Certain diseases** “e.g. Shock & nephrotic syndrome”



3. Chemical factors:

* Hormones

Thyroid h., Adrenaline, ACTH & Cortisone, G.H. & Male sex h. $\uparrow$ BMR

* Caffeine $\uparrow$ BMR

* Alcohol $\uparrow$ BMR “Increase heat loss due to cutaneous V.D. so $\uparrow$ BMR to maintain body temperature”

* Amphetamine $\uparrow$ BMR “used in

بعد شريحة 18 Metabolism Lecture 2

BMR increased in

- 1) Acromegaly
- 2) Starvation
- 3) Hypothermia
- 4) hypothyroidism

BMR increased in

- 1) Acromegaly
- 2) Starvation
- 3) Hypothermia
- 4) hypothyroidism



Def.

The SDA of a food is the obligatory energy expenditure that occurs during its assimilation into the body

Start 1 hour after food ingestion

Maximum within 4-5 hours



SDA OF DIFFERENT FOOD STUFFS

CHO → 6%

Fat → 4%

Protein → 30%

Mixed diet → 10%

Discuss the Importance of RQ

1)

2)

3)

4)

The SDA of a food & its Cause



It takes 30 kcal to assimilate the amount of protein sufficient to raise the metabolic rate 100 kcal;

6 kcal to assimilate a similar amount of carbohydrate;
and

5 kcal to assimilate a similar amount of fat

The cause of the SDA, which may last for many hours,
is uncertain

Factors affecting SDA



1- Type of food “High protein diet has higher SDA,

2- Amount of food “SDA is directly proportionated to the amount of food”



N.B.: *The heat produced as a result of SDA is above that produced by BMR & Work*

It is derived from energy stores So, ??????????????



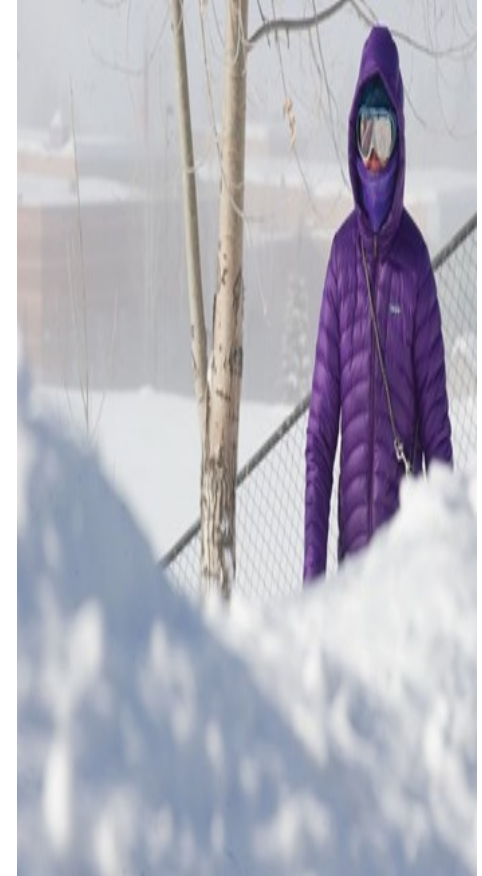
Prolonged protein ingestion would lead to loss of body

Factors affecting SDA



3- External temp. : The excess heat produced as a result of SDA is completely lost from the body at 33 degree centigrade

N.B.: If the external temp. ↓, SDA retained in the body, to maintain body temp nearly constant, as in cold weather



Lecture Quiz



Q1. Which of the following is the BMR in a normal adult male of average size?

- a) 40 Cal/h/m² b) 60 Cal/h/m² c) 90 Cal/h/m²

Q2. Which of the following increases the BMR maximally ?

- a) Sleep b) stress c)
Hyperthyroidism

Q 3. Which of the following food constituent has the highest SDA?

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SUGGESTED TEXTBOOKS



1. Ganong's "Review of Medical Physiology", 25th edition, chapter 72, pages 459-467
2. Guyton and Hall "Textbook of Medical Physiology", 12th edition, chapter 72, pages 863-865
3. Sembulingam "Essentials of Medical Physiology", 6th edition, chapter 124 page 710 & see also pages " 94, 360-363, 391, 398, 441, 464

